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Teaching Ergonomic and Haptonomic Patient Handling; the Feasibility of an On-Site Course in Clinical Practice for Nursing Students

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Abstract

This study aims to evaluate the feasibility (e.g., acceptability, demand, implementation, integration, and efficacy) of an ergonomic patient handling training based on the principles of haptonomy for nursing students. We conducted a mixed-method feasibility study; quantitative and qualitative methods were used to explore the feasibility. A total of 32 vocational and Bachelor student nurses working at two learning units participated in the study. Students at one learning unit (n=21) received the training, the other students did not. Most students found the training inspiring, motivating and a feasible approach for use and integration in a nursing curriculum. The mean rating for the training on a scale from 1 to 10 was 7.7 (range 5-10). A small reduction of musculoskeletal symptoms among students in the intervention group is promising regarding the effectiveness of the training.

Keywords: Ergonomics; Feasibility study; Haptonomy; Musculoskeletal symptoms; Nursing students

Background

Lifting, transferring, repositioning, and mobilizing patients as well as frequent and prolonged work in uncomfortable positions, contribute significantly to the high incidence of musculoskeletal symptoms (such as low back pain) in nurses [1-6]. These physical health symptoms already occur during nursing training [7-10]. Videman, OjajSrvi, RiihimSki, and Troup [11] showed in their study among 174 Finnish female nursing students that the incidence of low back pain sharply increased by the end of the nursing education and after graduation. These findings underscore the importance of early implementation of activities for the prevention of musculoskeletal symptoms and their sustainable application throughout working life.

Various intervention strategies are used to prevent the occurrence of musculoskeletal symptoms in nurses. The most common approach to prevent musculoskeletal symptoms among health care staff is teaching patient transfer techniques [12-13]. Such interventions have shown to have little effect on the nurses' way of working or on the occurrence of symptoms [14-19]. This may be partly due to an underuse of preventive measures in daily practice [14-18]. In addition, the effect of an ergonomic training has been shown to recede after six months [20].

A systematic review on preventive interventions for physical health complaints in nursing students and early career nurses, showed that evidence for the effectiveness of such interventions is scarce and often conflicting [21]. Of twelve interventions included in the review, eight involved training in patient handling, which in some studies was combined with theoretical knowledge. However, the effect on musculoskeletal symptoms was disappointing and contradictory. Studies with sufficiently long follow-up and appropriate outcome measures are scarce. In nursing education, skills training in patient transfer techniques is often limited to only a few hours school-based training [22].

At Rotterdam University of Applied Sciences, we studied how the nursing curriculum could be improved to enable nursing students to better cope with the physical and mental demands they face in nursing practice. An expert panel, consisting of registered nurses, nursing students, nursing lecturers (intermediate vocational and bachelor level), experts and researchers in the field of ergonomics and work & health, considered a training in ergonomic patient handling, based upon the principles of haptonomy, a promising intervention to improve patient transfer techniques in nursing students.

Static and postural stresses are major causes of back pain [4,23]. Static overload often occurs during activities such as washing, bathing or showering of patients. Nursing students are prone to activities both in in-hospital care and outside the hospital (e.g., studying at home), which makes them more vulnerable to muscle overloading, due to static and non-ergonomic postures [9]. Reduction of static overloading is central to the guidelines of the Dutch working environment covenants [24]. The conscious use of ergonomic principles, including the use of aids for moving, lifting and handling, in combination with haptonomic principles may contribute to a reduced risk of musculoskeletal symptoms due to patient handling tasks. Further information on the principles of haptonomy can be found in box 1.

In addition to the haptonomic component, the ergonomic patient handling training consisted of longer and more training sessions than the standard training, and can be delivered both at nursing school and in practice.

In this explorative study, we want to evaluate to what extent: (1) a training based on ergonomic patient handling with haptonomic principles is suitable, satisfying, attractive and instructive for nursing students (acceptability and demand); (2) the ergonomic patient handling training is feasible for use and integration in a nursing curriculum, and the training can be successfully delivered (implementation and integration); (3) students acquire the intended knowledge, skills and attitudes, so that targeted outcomes occur (efficacy).

Haptonomy is derived from the Greek words hapsis (touching, feeling) and nomos (patterns, laws, rules) [25]. Haptonomy is still a relatively young field of study, mainly known in the Netherlands and in France [26]. It has yielded good practical results in healthcare practice [27,28], but is not scientifically substantiated.

Patient transfer techniques integrating the principles of ergonomics and of haptonomy rely on the use of partial physical prompts to encourage the patient to perform the intended movement, thereby reducing the need for the nurse to use force. It needs a profound realization that the patient is not just a body to be moved, but an animated living being [27]. Relocations (transfers) thus become technically easier to perform.

An example of a haptonomic, non-verbal instruction is to indicate a direction of movement by placing a hand on that part of the body that the caregiver wants the patient to move. A soft touch followed by slow pressure must be applied without pushing or pulling, because very little force is needed to activate the basal neuromuscular sensors and to achieve the desired movement. Too much force can lead to resistance [29].

Working according to haptonomic principles also involves an awareness of the interpersonal space between patient and caregiver. Too much space can lead to uncertainty, discomfort and anxiety in the patient. Too little space can encourage the patient to start leaning on the caregiver. If the caregiver then gives more support, the passive response of the patient will further increase.

Individual patients differ greatly in how and why they move, so caregivers must adjust the haptonomic approach accordingly [30].

Box 1: Principles of haptonomy in patient care [25-30].

Methods

Design

A mixed-method feasibility study was conducted to determine the feasibility of the ergonomic patient handling training based on haptonomic principles. To assess the feasibility (acceptability, demand, implementation, integration, and efficacy), we used an evaluation model based on Bowen's feasibility study framework [31], which we combined with Kirkpatrick's training evaluation model [32] (Table 1).

Area of focus [a)]	Research questions [a)]	Outcomes of interest [a)]	Research instruments	Research population	Level of training evaluation [b)]
Acceptability	To what extent is the ergonomic patient handling training judged as suitable, satisfying or attractive to the students	1) Satisfaction 2) Perceived appropriateness	Post-training survey	Students, trainer and education manager and nursing skills course holder	Level 1: Reaction
Demand	To what extent is the ergonomic patient handling training likely to be used or applied by students?	1) Actual use 2) Expressed interest or intension to use	Post-training survey: reflection on training	Students	Level 3: Impact
Implementation	To what extent is the ergonomic patient handling training be successfully delivered to intended participants in some defined, but not fully controlled, context?	1) Degree of execution 2) Success or failure of execution	Post-training survey; Attendance list	Students, trainer and education manager and nursing skills course holder	Not Applicable
Integration	To what extent is the ergonomic patient handling training be integrated within the existing educational system or clinical placement setting?	1) Perceived fit with infrastructure 2) Perceived sustainability	Post-training survey	Students, education manager and nursing skills course holder	Not Applicable
Efficacy	To what degree students acquire the intended knowledge, skills and attitudes based on their participation in the ergonomic patient handling training?	1) Perceived knowledge 2) Perceived skills 3) Perceived attitudes	Post-training survey	Students	Level 2: Learning
Efficacy	To what degree to targeted outcomes occur as a result of ergonomic patient handling training?	4) Effects of the training on musculoskeletal symptoms	Pretest-posttest survey measuring: musculoskeletal symptoms	Students	Level 4: Result

Table 1: Evaluation model based on Bowen, et al. [31] and Kirkpatrick and Kirkpatrick [32] [a)](Bowen, et al.[31]); [b)] (Kirkpatrick & Kirkpatrick [32].

Participants and Setting

This feasibility study was conducted in Erasmus University Medical Center in Rotterdam, The Netherlands. The training was offered to nursing students (at both vocational and Bachelor level) who did a clinical placement in the clinical learning unit of trauma surgery, orthopaedics and plastic surgery. Participation in the research was facilitated by the clinical learning unit by integration of the training in the clinical placement activities. Nursing students from the clinical learning unit of urology and gynaecology acted as a control group. These students received only the questionnaires, but not the training.

Description of the Intervention

The ergonomic patient handling training was a tailored version of the basic training 'Physically safe & respectful working in care', developed by Hake [33]. This training is based on three pillars [34]: 1) a good working posture. 2) working according to health and safety standards 3) taking care that the client cooperates according to the best of their ability ('haptonomic working'). The training consisted of two 3-hour sessions, with a theoretical and practical component (Table 2).

Session, duration	Theoretical content (basic principles) [34]	Practical content (Parts of the training)
Session 1; 3 hours	• Relevant health and safety standards and how to work with them. • Work posture in general (in various settings). • Working posture at the bedside. • What is haptonomic work and how to apply it? • Cooperation of the patient to the best of his ability. • Alternatives for squatting and kneeling. • Dealing with clients who do not understand words properly, such as clients with dementia, aphasia and/or mental disability.	• Transfer from seat (bed edge / chair) to position and back. • Assistance in and out of bed. • Experiencing how patient transfers can be done differently (on a haptonomic basis) and why.
Session 2; 3 hours	• Summary of previous session. • Handling of compression stockings from pressure class two onwards. • Schedule for tilting and use of sliding tarpaulin. • Lifting, pushing & pulling (manoeuvring the wheelchair).	• Bed: tilt on the side • Bed: moving within the boundaries of the bed / working with sliding sheets • Experiencing how patient transfers can be done differently (on a haptonomic basis) and why.

Table 2: Training content transfer techniques and caring.

Training Materials: Students were provided with a handout, and had access to the book 'Basic book transfer techniques for health care professionals' [34] and the online e-learning programme consisting of ten modules, including, 'Lifting from and in bed', 'Rise and sit' and 'Donning and doffing compression stockings'.

Trainer: The training was developed and provided by an experienced physiotherapist, haptonomist and trainer in patient transfer techniques on a haptonomic basis [34].

Procedure: Students in the intervention group were split into three training groups to limit the group size (the maximum was set at ten). Each group was scheduled for two training sessions with a 2-4 week interval between the sessions (February and March 2020).

Data Collection

The data collection for this study started in February 2020 and follow-up was concluded 10 weeks after, in April 2020.

The feasibility aspects (acceptability, demand, implementation, integration) were investigated quantitatively and qualitatively using:

1. a post-training survey, containing self-formulated closed and open-ended questions on all feasibility aspects, completed by students who followed the training.
2. semi-structured interviews, one with the trainer and one with both the education manager and the nursing skills course holder (Table 1). The interviews took place after the follow-up measurements. A topic list was used, addressing a selection of the feasibility aspects (Table 1).
3. In addition, an attendance list was kept for registration of participation (implementation).

To explore efficacy, we did a pretest-posttest survey containing validated instruments and self-formulated questions, completed by all participating students (Table 3). Questions included sociodemographic characteristics (sex, age, height, weight, first language and study route), musculoskeletal symptoms, physical work exposure (lifting and bending), and sick leave and absence. The potential score range for lifting and bending is 0-100; a score between 50 and 80 indicates a substantial physical exposure of between 50 and 80 major physical tasks per workday [35].

Three self-formulated questions were used to find out the knowledge and application of the national guidelines on healthy and safe working as documented in the Health and Safety Catalogue. We included various self-formulated questions, to obtain information on the number of colleagues and number of patients the students worked with. A detailed description of the validated questionnaires that are mentioned in (Table 3) can be found in the SPRiNG cohort study protocol [36].

Outcome measure	Questionnaire	Measuring moments
Musculoskeletal symptoms, physical workplace characteristics		
Physical health symptoms	Musculoskeletal symptoms; neck, back, limbs (DMQ) [37]	• Prior to training • 10 weeks after starting the clinical placement
Physical work exposure	Lifting and bending (NEXT) [35]	• 10 weeks after starting the clinical placement
Physical work exposure	Monitor work (VBBA) [38]	• 10 weeks after starting the clinical placement
Sick leave / absence	'Gezond werken in de zorg' [Healthy Working in Healthcare] questionnaire [39] Nationale Enquête Arbeidsomstandigheden (NEA) [National Labour Survey] [40]	• Prior to training • 10 weeks after starting the clinical placement
Absence and support for physical symptoms during the clinical placement/ working period	Use of support for physical health symptoms 'Gezond werken in de zorg' [Healthy Working in Healthcare] Questionnaire [39]	• Prior to training • 10 weeks after starting the clinical placement
Number of colleagues during a dayshift	self-formulated	• 10 weeks after starting the clinical placement
Average number of patients during a dayshift	self-formulated	• 10 weeks after starting the clinical placement
National guidelines on healthy and safe working		
Healthy and safe working in health care	self-formulated	• 10 weeks after starting the clinical placement

Table 3: Overview of the study outcome measures and scales for the evaluation of the efficacy (pre- posttest measurement, all students).

Statistical Analysis

Quantitative survey data were analysed using SPSS version 26 (SPSS, Inc., Chicago, IL, USA) for Windows. Descriptive statistics were used to analyse background characteristics and all outcomes at baseline and follow-up. We checked the normality of distributions for all characteristics. Answers on the open questions in the survey as well as the interview transcripts were analysed qualitatively and descriptively, using codes derived from the learning objectives and feasibility aspects from Bowen et al. [31] and Kirkpatrick and Kirkpatrick [32]. Power was deemed inadequate to demonstrate significant changes in musculoskeletal symptoms.

Ethical Considerations

Ethical approval was obtained from the Medical Ethical Review Committee of the Erasmus University Medical Center Rotterdam (MEC-2019-0638). The research was carried out in accordance with the Netherlands Code of Conduct for Research Integrity [41]. Before being approached for participation, all participants received oral and written information about the study. All participants gave written informed consent. This research was conducted according to the requirements of the Helsinki Declaration (2008).

Results

Characteristics of the Study Population

In total, 33 students participated in this study, 21 in the intervention group and 12 in the control group. All 33 students took part in the pre-test survey and 32 students in the post-test survey; the one student lost to follow-up participated in the control group and had to terminate her clinical placement prematurely for unknown reasons.

The mean age of the students in the intervention group was 20 years (range 16-28, SD 2.69). Three students in this group were male. The mean age of the students in the control group was also 20 years (range 18-25, SD 2.06). In this group, all students were female. Most students in both intervention and control group were in their third or fourth year of nursing education (18 students in the intervention group, and 11 in the control group). Eleven students in the intervention group and four students in the control group did the intermediate vocational degree nursing training. In the intervention group, a majority of 15 students studied fulltime; in the control group, all students studied full time (Table 4).

Pre-measurement	Total N (%) unless specified otherwise	Intervention N (%) unless specified oth-erwise	Control N (%) unless specified oth-erwise
Sample size, N	33	21	12
Sex (% female)	30 (90.9%)	18 (85.7%)	12 (100%)
Age (years), mean ± SD (range)	20.4 ± 2.5 (16-28)	20.4 ± 2.7 (16-28)	20.3 ± 2.1 (18-25)
BMI (kg/m2), mean ± SD (range)	23.7 ± 4.2 (16.7-32.2)	24.7 ± 4.4 (17.5-32.2)	22.1 ± 3.5 (16.7-31.0)
Height (cm), mean ± SD (range)	170.4 ± 7.0 (158-190)	171.4 ± 7.6 (158-190)	168.8 ± 5.6 (161-177)
Weight (kg), mean ± SD (range)	69.2 ± 14.6 (50-102)	72.6 ± 15.0 (50-102)	63.2 ± 12.3 51-95
Current nursing education			
% intermediate vocational degree training	15 (45.5%)	11 (52.4%)	4 (33.3%)
% bachelor degree training	18 (54.5%)	10 (47.6%)	8 (66.7%)
Current study year			
% year 1	2 (6.1%)	2 (9.5%)	-
% year 2	2 (6.1%)	1 (4.8%)	1 (8.3%)
% year 3	20 (60.6%)	11 (52.4%)	9 (75%)
% year 4	9 (27.3%)	7 (33.3%)	2 (16.7%)
Educational route			
% fulltime programme	27 (81.8%)	15 (71.4%)	12 (100%)
% work-study programme	6 (18.2%)	6 (28.6%)	-
% Dutch as a first language (% yes)	30 (90.9%)	19 (90.5%)	11 (91.7%)

Table 4: Background characteristics of participants.

Evaluation of the Training

Acceptability

The post-training survey (Figure 1) showed that most of the 21 students were satisfied with the training. The mean overall rating for the content and delivery of the training was 7.7 (SD 1.19) on a scale from 1-10. All students found that the trainer demonstrated sufficient professional knowledge, and the majority considered the content of the training as educating, activating, inspiring and motivating.

About two thirds of the students considered the techniques learned in the training to be appropriate to apply in their clinical placement and a majority of students confirmed that the training is suitable for application in daily nursing practice. All but one student thought that the training should be offered to all nursing students.

According to the trainer, the students were eager to participate in the training. She had not experienced any reluctance, though sometimes was confronted with disbelief, with students asking questions like: *"Is this* [the haptonomic approach] *really applicable in practice? It is nice what we practice on each other here, but what if it is with a real client?"*.

Most students considered the training to be suitable, satisfying, favourable, and relevant to apply, both at nursing school and at clinical placement. This corresponds to a positive learning outcome on Kirkpatrick's level 1: reaction.

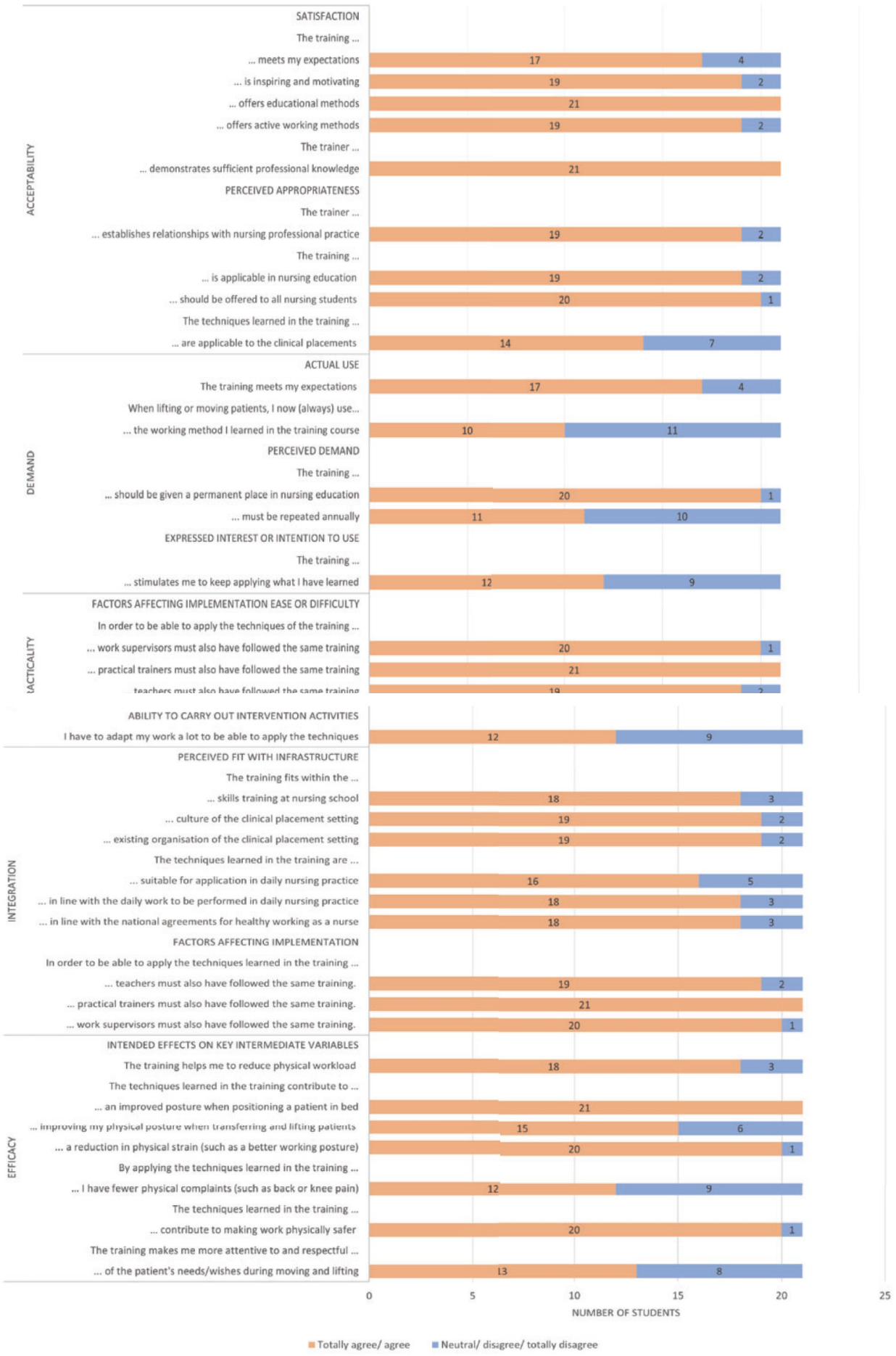
SATISFACTION
The training ...
... meets my expectations 17 4
... is inspiring and motivating 19 2
... offers educational methods 21
... offers active working methods 19 2
ACCEPTABILITY
The trainer ...
... demonstrates sufficient professional knowledge 21
PERCEIVED APPROPRIATENESS
The trainer ...
... establishes relationships with nursing professional practice 19 2
The training ...
... is applicable in nursing education 19 2
... should be offered to all nursing students 20 1
The techniques learned in the training ...
... are applicable to the clinical placements 14 7
ACTUAL USE
The training meets my expectations 17 4
When lifting or moving patients, I now (always) use...
... the working method I learned in the training course 10 11
DEMAND
PERCEIVED DEMAND
The training ...
... should be given a permanent place in nursing education 20 1
... must be repeated annually 11 10
EXPRESSED INTEREST OR INTENTION TO USE
The training ...
... stimulates me to keep applying what I have learned 12 9
FACTORS AFFECTING IMPLEMENTATION EASE OR DIFFICULTY
In order to be able to apply the techniques of the training ...
... work supervisors must also have followed the same training 20 1
... practical trainers must also have followed the same training 21
ABILITY TO CARRY OUT INTERVENTION ACTIVITIES
I have to adapt my work a lot to be able to apply the techniques 12 9
PERCEIVED FIT WITH INFRASTRUCTURE
The training fits within the ...
... skills training at nursing school 18 3
... culture of the clinical placement setting 19 2
... existing organisation of the clinical placement setting 19 2
INTEGRATION
The techniques learned in the training are ...
... suitable for application in daily nursing practice 16 5
... in line with the daily work to be performed in daily nursing practice 18 3
... in line with the national agreements for healthy working as a nurse 18 3
FACTORS AFFECTING IMPLEMENTATION
In order to be able to apply the techniques learned in the training ...
... teachers must also have followed the same training. 19 2
... practical trainers must also have followed the same training. 21
... work supervisors must also have followed the same training. 20 1
INTENDED EFFECTS ON KEY INTERMEDIATE VARIABLES
The training helps me to reduce physical workload 18 3
The techniques learned in the training contribute to ...
... an improved posture when positioning a patient in bed 21
... improving my physical posture when transferring and lifting patients 15 6
... a reduction in physical strain (such as a better working posture) 20 1
EFFICACY
By applying the techniques learned in the training ...
... I have fewer physical complaints (such as back or knee pain) 12 9
The techniques learned in the training ...
... contribute to making work physically safer 20 1
The training makes me more attentive to and respectful ...
... of the patient's needs/wishes during moving and lifting 13 8
0 5 10 15 20 25
NUMBER OF STUDENTS
Totally agree/ agree
Neutral/ disagree/ totally disagree

Figure 1: Evaluation of the intervention (N=21).

Demand

Actual Use

About half of the students in the intervention group stated that they applied the techniques they learned during the training when lifting or moving patients.

Perceived Demand

Most students stated that the training should be given a permanent place in nursing education and just over half of the students (totally) agreed that training must be repeated annually.

The education manager and the nursing skills course holder agreed that nursing students need proper skills to prevent or reduce physical symptoms. Students should be made aware of and realise the importance of moving patients correctly, with attention to their own posture, to prevent or reduce physical symptoms. Both manager and course holder thought that it might be valuable to provide a refresher training to third-year students who are in the early stages of their clinical placement. It still needs to be discussed, however, whether this refresher training should be optional (voluntary) or mandatory.

Intent to Continue Use

About half of the students stated that the training stimulated them to continue to apply what they had learned. However, they had also a major comment about the training. It must also be offered to graduate nursing staff at the clinical placements, if it is to work properly.-

"It is difficult to integrate it into my work because colleagues have not had the training. Because of this, I notice that sometimes you still help someone up under the armpits because a colleague is used to that and it has to be done quickly. It would be great if everyone followed the training so that a single line can be drawn." (Female student, 20 years, fourth year, Bachelor level)

When learning about techniques that require tools, the tools must be available in the clinical placement.

"Sometimes this [applying the proper technique] is still difficult because the materials are not fully available, such as a sliding sheet." (Female student, 20 years, fourth year, Bachelor level)

These findings correspond to a moderately positive outcome in behavioural change in Kirkpatrick's learning level 3; The acquired knowledge can only be applied in the participant's (working) environment if the preconditions are also met.

Practicality

Most students in the intervention group attended both training sessions. Three students attended only the first session and one student only the second one. Reasons for not attending one of the sessions were nightshifts and days off. Twelve students had used the book and three students had used the e-learning programme. Reasons for not using the book were lack of time, forgotten and overlooked (1 student each). Reasons for not using the e-learning programme were forgotten (8 students), lack of time (4 students), not interested or no need for it (3 students), and could not access the site (3 students). The interviewed trainer mentioned that the training duration had been too short to pay attention to the book and the e-learning.

The students made some suggestions for improvement of the training regarding: (1) delivery of the training in the context of real practice, and with real patients; (2) expansion of the training to graduated nurses; (3) availability of aids in daily practice; (4) the number of training sessions.

"Give the training on the ward in the presence of patients. Apply directly to a patient." (Female student, 22 years, third year, Bachelor level)

The education manager and nursing skills course holder were positive towards the training concept, but also expressed their hesitancy to introduce it into nursing education due to the already overloaded curriculum.

"We are in the process of a curriculum review, which of course offers possibilities to investigate or to discuss with each other where it can be embedded in the curriculum. But again, our curriculum is really very full." (education manager)

According to the education manager and nursing skills course holder, it is preferable to adapt the current training by integrating some of the principles of haptonomy, to gain a quick win for further implementation of the new approach within the current curriculum.

"To introduce the training into nursing education on a large scale, it is first necessary to look at what and how it is done now and to see if there are any quick wins to fully integrate it within the whole professional teaching team." (education manager)

The trainer emphasised that students and healthcare professionals need to realize that it takes time and practice to master the techniques of the ergonomic patient handling training.

Integration

The majority of students had the opinion that the training should be given a permanent place in the nursing curriculum and 11 of 21 students thought that the training should be repeated once a year.

Both the education manager and nursing skills course holder acknowledged that there is room for improvement. Currently, training in patient transfer techniques is offered only once in the first year of the nursing curriculum. They both believe that the timing of the training within the curriculum is essential and that the training preferably should be offered shortly before students go on placement. According to them regular refreshment of what has been learned in training is equally important. Moreover, the proper integration of the principles of haptonomy in the lessons should be watched over continuously, and the teachers involved should be skilled. A train-the-trainer course may be useful. Cooperation with clinical placement settings in this matter is essential, but difficult.

"The biggest challenge remains, and will remain for a long time to come, that the clinical placement settings must then also adopt it. [….] I think that because of the delusions of the day, it is just enormously complicated to make time for this as a nurse, to get time for it." (education manager)

The opinion of the trainer in this matter was clear; the training should be given in all nursing schools for nursing students, with regular refresher training, but also in practice for all graduated nurses, so that students and graduates use the same techniques.

Efficacy

All students agreed with the proposition that the methodologies in the training course contribute to an improved posture when moving patients in bed, and 18 students agreed that the training contributes to reduce physical workload (Figure 1).

Twelve students mentioned that by applying the techniques from the training, they experienced fewer musculoskeletal symptoms (such as backache or knee pain). Also, 20 students indicated that the training techniques contribute to making work physically safer, and 13 students had the opinion that the training made them more attentive to and respectful of the patient's needs/wishes during moving and lifting activities.

Students in the intervention group had post-intervention more small positive changes in the occurrence of musculoskeletal symptoms, compared to students in the control group who had not received the intervention. (Figure 2).

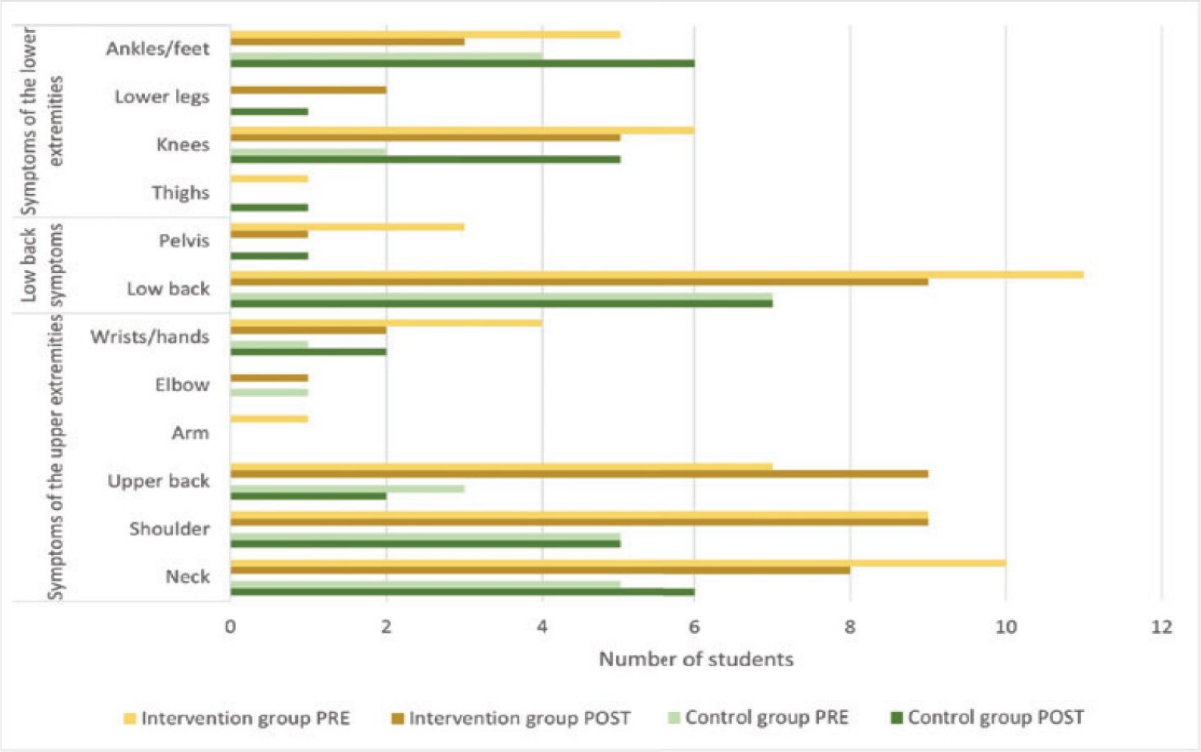

Figure 2: Musculoskeletal symptoms before and 10 weeks after the intervention between groups.

In answer to the open-ended question on the most important added value of the 'Ergonomic patient handling training', students mentioned an increased understanding of a correct posture and of haptonomic principles, and the experienced benefits of applying the newly learned techniques in moving and transferring patients.

"The awareness that posture and small changes can make a big difference. That all work in healthcare does NOT have to be physically demanding. A statement of which I was astonished, but now I believe in it." (Female student, 21 years, third year, Bachelor level)

"Through this training I became aware that your posture has a lot of influence on your body and that you have to pay attention to that to avoid physical symptoms." (Female student, 20 years, third year, Bachelor level)

In the intervention group, there was a decrease in prevalence of symptoms of the neck (two students less) and of the low back (two students less), whereas in the control group there was an increase of neck symptoms (one student more), and no change was seen in the low back symptoms.

In the intervention group, there was a decrease in prevalence of symptoms of the ankle/foot (two students less), whereas in the control group two students had an increase of ankle/foot symptoms. In both groups, there was a slight increase of visits to a care provider for musculoskeletal symptoms (one student more in the intervention group, and two students more in the control group) (Figure 2). Both groups had to perform lifting and bending activities; students in the intervention group had higher scores for lifting and bending (mean ± SD; 29.05 ± 13.98) compared to students in the control group (mean ± SD; 18.86 ± 8.88). For both groups the lifting and bending scores remained well below 50. A score between 50 and 80 indicates a substantial physical exposure of between 50 and 80 major physical tasks per workday.

The education manager and nursing skills course holder expressed their concern about the high prevalence of musculoskeletal symptoms among nursing students. The figures evoked recognition. They were, however, somewhat pessimistic about the adherence to safe patient handling techniques in clinical practice, especially when there is a gap between learned skills and practical reality. Thus, the occurrence of musculoskeletal symptoms seems almost inevitable.

"The longer people [i.e., nurses] *work in the field, the more they make their own way in whatever they do. The work protocol is gradually abandoned and more and more they find their own way that works, sort of, for that person."* (nursing skills course holder).

Discussion

This study explored the feasibility of a training based on ergonomic patient handling techniques.

As for the acceptability of the training, the students were largely positive about the theoretical and practical content, the clarity of the goals, the expertise of the trainer, the educational material and the training's practicality. Students believe that the training should be offered to all nursing students. There are, however, a number of challenges concerning the integration of the current training in the nursing curriculum. We believe that offering the training at the clinical placement site may have the advantage that not only nurse students, but also registered nurses and other direct patient care staff can participate. First, it is important that all care professionals have knowledge of, accept the principles of, and work conform the ergonomic conventions, maintaining a correct posture and using haptonomy to invite patients to move with you. Only then, registered nurses can function as role models. Second, patient-handling training may be more meaningful in the clinical placement setting, as the learned techniques can be directly put into practice. Dehghani, Ghanavati, Soltan, Aghakhani, and Haghpanah [42] found that nursing students who obtained clinical competency at the clinical placement demonstrated a better communication and cooperation with their instructor and with each other. They were more confident and had better understanding, and the amount of learning in practical skills was enhanced.

Drawbacks of on-site training are the large number of clinical placements in varying settings. As a consequence, delivery of the training to all students cannot be ensured. For some settings, in particular mental health care, a training of patient handling techniques may be less important. Moreover, it may not be efficient to organise the two-session training in a setting with only a small number of nursing students placed.

In the end, broad management support and cooperation between nursing education and clinical placement settings is essential for a profound implementation of such training. ErgoCoaches, trained ward nurses who are specialised in applying ergonomic principles, should ensure that the right actions are actually taken [43,44]. The heavy workload in clinical practice contributes to the lack of attention to ergonomic work among both students and qualified nurses. It is also important that when ergonomic interventions are taught to students at school, they should also be embraced and incorporated in practice [45]. This will have a positive effect on the impact of the intervention.

We also found that for some of the students in our study, it was not possible to apply the learned techniques in clinical practice. First, they were confronted with the unavailability of materials needed to apply the principles of ergonomic patient handling, such as a ReadySlide, a thin and foldable sliding sheet to ease various types of transfers, an Easy-Slide and a SlideX, additional tools for donning and doffing elastic stockings by caregivers. Second, students mentioned that the colleagues they worked with were not familiar with these techniques. As mentioned-above, this warrants training of both students and clinical supervisors, trainers and other nurses at the clinical placement site. A systematic review by Koppelaar et al.[46] showed that several barriers and facilitators may influence the implementation of preventive interventions on patient handling in health care, including individual factors (e.g., motivation and ability), and environmental factors (e.g., social support, wide appeal, or patient-related factors). All such factors should be considered for successful implementation of ergonomic patient handling. Olinski and Norton [47] in detail describe the efforts to implement a safe patient-handling programme over a period of eight years. They indicated that the challenge lies in the sustainability of the initial benefits of the program and creating a culture change within the organisation.

We did not aim to assess the effectiveness of the techniques of ergonomic patient handling, but the comparison of the presence of musculoskeletal symptoms in the intervention or control group at baseline and the end of our study showed a tendency in favour of the training for symptoms of the lower extremities in particular.

In addition to a decrease in musculoskeletal symptoms in the intervention group, the principles of haptonomy could also have contributed to better patient outcomes. These principles are based on touch [29,30]. Touching patients in nursing is very common. Nurses touch patients regularly in various activities, such as giving instructions, bathing, and patient transfers. It is a valued aspect of providing care. Touch calms, reassures, shares warmth and provides stimulation [48]. The effect of expressive physical touch with verbalisation on anxiety and dysfunctional behaviour in clients with dementia was investigated by Kim and Buschmann [49]. They found that anxiety is lower immediately following expressive physical touch with verbalization and that expressive physical touch with verbalization causes decreasing episodes of dysfunctional behaviour [49]. The use of haptonomic principles during patient transfer activities contributes to a better mutual understanding between nurse and patient. Students in our study showed an increased awareness of the potential value of integrating ergonomic and haptonomic principles in patient transfer techniques. Some of them had experienced positive effects. It is important that when subjects such as an ergonomic patient handling training are taught to nursing students at school, this has to be embraced by the clinical placements as well. Further research into the effectiveness of an ergonomic patient handling training is needed.

Strengths and Limitations

To our knowledge, our study is the first to study the feasibility of an ergonomic patient-handling training that is based on the principles of haptonomy. A strength of our study is the use of the feasibility framework of Bowen [31] combined with the four levels of Kirkpatrick's evaluation model [32], as well as the use of a pre-post design, with an intervention and control group. Another strength was that the questionnaire used had been tested for face validity.

A limitation could be that the obtained data was measured on self-reported and not on observed behaviour. Self-reporting may contain social desirability bias. To address social desirability bias, we maintained subject anonymity and assured confidentiality [50]. In addition, the results of our study should be interpreted with caution, because this study is limited in scale, scope and sample size, as is inherent to most feasibility studies. In addition, the study groups and the clinical placement settings were not fully comparable, and, therefore, the tentatively positive results concerning the effectiveness of the training should be considered with extra caution.

The COVID-19 pandemic may have influenced the findings, as various students were relocated to other clinical placement settings after finishing the training. They were unable to put the learned activities into practice at their original clinical placement setting, but they could apply it in a different placement setting. In this study, we did not assess the areas Adaptation, Practicality and Expansion of Bowen's framework; thus, it is not known to what extent the training is feasible with regard to these aspects.

Implications for Research and Practice

The feasibility including efficacy and effectiveness of the training should be further explored. The current study results can serve as a basis for further research on the effectiveness of the ergonomic patient handling techniques, using a randomised controlled-trial design.

For students to be able to work according to the principles of safe and respectful patient handling, support from management in practice and at the clinical placement, as well as training of faculty staff, clinical supervisors and mentors is necessary.

Conclusion

Overall, we can conclude that students regarded the training based on ergonomic patient handling techniques including the principles of haptonomy as suitable, satisfying, attractive, and instructive. They also considered it feasible for use and integration in a nursing curriculum, and that it should be offered to all students. At management level, concerns were raised for integration of the training, including the already overloaded curriculum. Regular repetition of the training is necessary to ensure that what has been learned is retained. To properly implement such training within the nursing curriculum, support from the education manager and clinical placement settings is indispensable. The training increased the students' awareness of proper patient handling; small changes in the occurrence of musculoskeletal symptoms are promising for the training effectiveness.

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